Topic: Limits of composites

Question: Use the given functions to evaluate the limit.

$$\lim_{x \to 5} f[g(x)]$$

when $f(x) = x^3$ and $g(x) = x^2 + 3$

Answer choices:

A $\lim_{x \to 5} f[g(x)] = 21{,}952$

B $\lim_{x \to 5} f[g(x)] = 81$

C $\lim_{x \to 5} f[g(x)] = 15{,}628$

D $\lim_{x \to 5} f[g(x)] = 253$

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Solution: A

To solve a limit that involves the composition of two functions, find the limit of the interior function, then solve the exterior function. This looks like

$$\lim_{x \to a} f[g(x)] = f[\lim_{x \to a} g(x)]$$

To solve, first rearrange the given limit.

$$\lim_{x \to 5} f[g(x)]$$

$$f[\lim_{x \to 5} g(x)]$$

Next we can substitute for $g(x)$.

$$f[\lim(x^2 + 3)]$$

$$f(5^2 + 3)$$

$$f(25 + 3)$$

$$f(28)$$

Now we can solve for $f(28)$.

$$f(x) = x^3$$

$$f(28) = 28^3$$

$$f(28) = 21{,}952$$

This is the value of the composite.

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Topic: Limits of composites

Question: Use the given functions to evaluate the limit.

$$\lim_{x \to -4} f[g(x)]$$

when $f(x) = \cos(x)$ and $g(x) = x + 4$

Answer choices:

A $\lim_{x \to -4} f[g(x)] = -1$

B $\lim_{x \to -4} f[g(x)] = 0$

C $\lim_{x \to -4} f[g(x)] = 1$

D The limits does not exist (DNE)

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Solution: C

To solve a limit that involves the composition of two functions, find the limit of the interior function, then solve the exterior function. This looks like

$$\lim_{x\to a} f[g(x)] = f[\lim_{x\to a} g(x)]$$

To solve, first rearrange the given limit.

$$\lim_{x\to -4} f[g(x)]$$

$$f[\lim_{x\to -4} g(x)]$$

Next we can substitute for $g(x)$.

$$f[\lim_{x\to -4} (x+4)]$$

$$f(-4+4)$$

$$f(0)$$

Now we can solve for $f(0)$.

$$f(x) = \cos(x)$$

$$f(0) = \cos(0)$$

$$f(0) = 1$$

This is the value of the composite.

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Topic: Limits of composites

Question: Use the given functions to evaluate the limit.

$$\lim_{x \to 3} f[g(x)]$$

when $f(x) = x^2 - 2x - 4$ and $g(x) = 5x - 5$

Answer choices:

A $\lim_{x \to 3} f[g(x)] = 0$

B $\lim_{x \to 3} f[g(x)] = 76$

C $\lim_{x \to 3} f[g(x)] = 10$

D $\lim_{x \to 3} f[g(x)] = \infty$

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Solution: B

To solve a limit that involves the composition of two functions, find the limit of the interior function, then solve the exterior function. This looks like

$$\lim_{x \to a} f[g(x)] = f[\lim_{x \to a} g(x)]$$

To solve, first rearrange the given limit.

$$\lim_{x \to 3} f[g(x)]$$

$$f[\lim_{x \to 3} g(x)]$$

Next we can substitute for $g(x)$.

$$f[\lim_{x \to 3}(5x - 5)]$$

$$f[5(3) - 5]$$

$$f(10)$$

Now we can solve for $f(10)$.

$$f(x) = x^2 - 2x - 4$$

$$f(10) = (10)^2 - 2(10) - 4$$

$$f(10) = 100 - 20 - 4$$

$$f(10) = 76$$

This is the value of the composite.

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